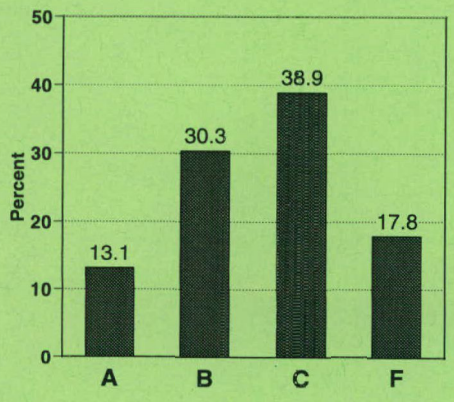
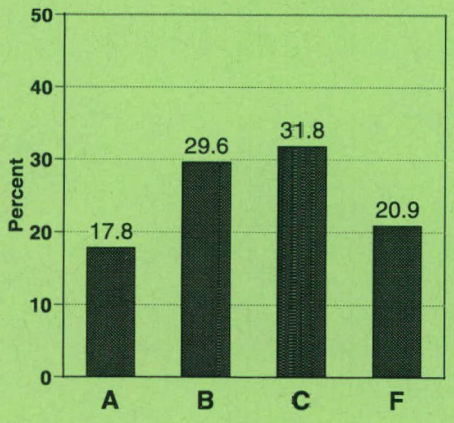
Mathematics 33

Diploma Examination Results
Examiners' Report for June 1997

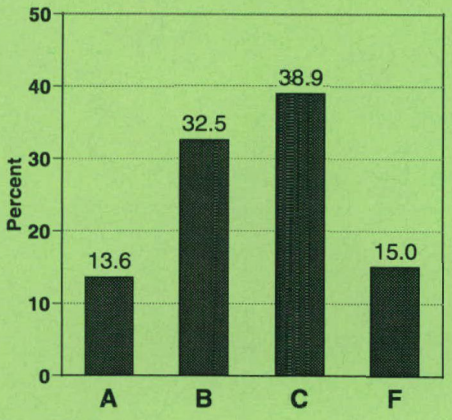
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1997 administration of the Mathematics 33 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. A provincial report containing a detailed analysis of the combined November, January, June, and August results is made available annually.

Description of the Examination

The Mathematics 33 Diploma Examination consists of 37 multiple-choice questions worth 53%, 12 numerical-response questions worth 17%, and four written-response questions worth 30% of the total examination.

Achievement of Standards

The information reported is based on the final course marks achieved by 5 645 students who wrote the June 1997 examination.

- 85.0% of the 5 645 students achieved the acceptable standard (a final course mark of 50% or higher).
- 13.6% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 50.6% of the students who wrote the June 1997 examination were female.

- 85.6% of the female students achieved the acceptable standard (a final course mark of 50% or higher).
- 14.6% of these female students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 49.4% of the students who wrote the June 1997 examination were male.

- 84.3% of the male students achieved the acceptable standard (a final course mark of 50% or higher).
- 12.4% of these male students achieved the standard of excellence (a final course mark of 80% or higher).

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Provincial Averages

- The average school-awarded mark was 61.8%.
- The average diploma examination mark was 63.0%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 62.9%.

Of the 5 645 students who wrote the June 1997 examination, 356 had written at least one Mathematics 33 Diploma Examination previously.

Results and Examiners' Comments

In the table below, machine-scored diploma examination questions are classified by question type: multiple choice (MC) and numerical response (NR). The correct answer for each question is provided under the column labelled "Key" and the proportion (out of 1) of students answering the question correctly is provided under the column labelled "Difficulty." The "Difficulty" is the mean score achieved on a question by all students who wrote the examination. Questions are also classified by core content areas of the course and areas of mathematical understanding. The abbreviations for these areas are expanded in results that follow the table.

Blueprint

Question	Key	Difficulty	RF	Q	PR	RE	TR	ST	AML	Math Und.
MC1	A	0.602	✓							C
MC2	A	0.885		✓						C
NR1	1.75	0.636	✓							P
MC3	D	0.565	✓							C
NR2	12	0.787	✓							C
MC4	D	0.809	✓							P
NR3	5.5	0.629	✓							P
MC5	A	0.439	✓							C
MC6	B	0.435		✓						C
MC7	A	0.542		✓						PS
NR4	21	0.655		✓						C
WR1	-	0.498	✓	✓						PCPS
MC8	C	0.809							✓	P
MC9	D	0.683		✓						P
MC10	A	0.583							✓	C
WR2	-	0.738							✓	PCPS
MC11	A	0.703			✓					PS
MC12	D	0.452	✓							C
NR5	1.71	0.416				✓				P
MC13	B	0.700						✓		P
MC14	C	0.780						✓		P
WR3	-	0.528					✓			PCPS
NR6	1.50	0.714							✓	PS
NR7	605	0.683							✓	P
MC15	B	0.693				✓				P
MC16	A	0.763				✓				P
MC17	C	0.630				✓				PS
MC18	C	0.588				✓				P
MC19	B	0.860			✓					P
MC20	D	0.719			✓					P
MC21	A	0.656			✓					P
NR8	1.02	0.650			✓					PS
MC22	C	0.824					✓			PS
MC23	D	0.487					✓			C
MC24	B	0.607					✓			C

Question	Key	Difficulty	RF	Q	PR	RE	TR	ST	AML	Math Und.
MC25	C	0.766	✓							C
NR9	30.5	0.886	✓							P
MC26	C	0.486		✓						P
MC27	C	0.743					✓			PS
MC28	D	0.568					✓			PS
MC29	A	0.530						✓		PS
MC30	A	0.394					✓			C
MC31	B	0.547					✓			P
NR10	2.22	0.422	✓							PS
MC32	B	0.547					✓			PS
MC33	C	0.802						✓		C
MC34	B	0.665				✓				PS
MC35	A	0.565		✓						P
NR11	20	0.475						✓		PS
MC36	C	0.723		✓						P
WR4	-	0.646	✓	✓			✓			PCPS
MC37	A	0.920					✓			C
NR12	2.06	0.448					✓			PS

Subtests: Machine Scored and Written Response (Average by Subtest)

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared.

Results are in average raw scores.

Machine scored: 31.5 out of 49

Written response: 12.6 out of 21

Course Emphasis on Machine-Scored Questions

RF	Relations and Functions	7.0 out of 11
Q	Quadratic Functions and Equations	5.0 out of 8
PR	Powers and Radicals	3.6 out of 5
RE	Polynomials and Rational Expressions	3.8 out of 6
TR	Trigonometry	6.0 out of 10
ST	Statistics	3.3 out of 5
AML	Annuities, Mortgages, and Loans	2.8 out of 4

Mathematical Understandings* on Machine-Scored Questions

Compared with the January 1997 examination, the results of the June 1997 examination showed a 20% increase in problem solving (8.5 out of 14 compared with 5.7 out of 14).

Procedural (P): 13.6 out of 20
Conceptual (C): 9.4 out of 15
Problem Solving (PS): 8.5 out of 14

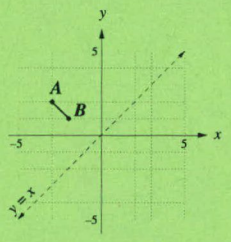
*Refer to Appendix D of the 1997–98 *Mathematics 33 Information Bulletin, Diploma Examinations Program*, for an explanation of mathematical understandings.

Multiple-Choice and Numerical-Response Questions

Questions on the examination were grouped around scenarios or practical situations that occur in real life. Recent partners have assisted teachers with the scenarios and questions they wrote for the 1997 examination. For the 1997 Mathematics 33 examinations, Olds and Fairview College instructors have assisted with the agricultural scenarios, Canadian Airlines and Pratt and Whitney employees assisted with the airline and aerospace scenarios, and personnel at Canada Olympic Park assisted in creating the sports and recreation scenario. The multiple-choice, numerical-response, and written-response questions were mixed within the scenarios of the examination, and where appropriate, questions from the same unit of the course were organized together. Teachers involved in the marking session stated that students responded very positively to the exam, liked the scenarios, and felt the examination was very fair. A discussion of how well students met the curriculum standards in the unit Relations and Functions and the unit Statistics follows.

Use the following information to answer the next question.

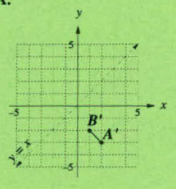
The graph of a function is displayed below. It is the line segment joining the points $A(-3, 2)$ and $B(-2, 1)$.



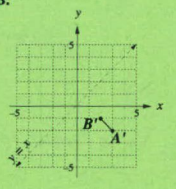
The inverse of this function is needed to solve a problem.

5. Which of the following is the graph of the inverse function?

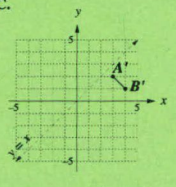
*A.



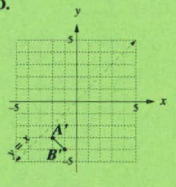
B.



C.



D.



Numerical Response

2. The domain of the function $f(x) = \frac{x}{x-12}$ is the set of all real numbers **except** for the number _____.

(Record your answer on the answer sheet.)

Answer: 12

Relations and Functions — To achieve the standards for relations and functions, students should be able to apply the concepts within relations and functions to describe real-life phenomena that can be expressed in two variables. This includes understanding the relationship between ordered pairs, the generalized form, and the graphical representations. Multiple-choice questions 5 and 12 and numerical-response questions 2 and 3 are examples of questions written to ensure students achieve the standards.

Multiple-choice question 5 involves determining the inverse of a function when provided with the graph of a function. In the past, student performance has been very weak in this area, as students appeared to confuse inverse relations with the concept of the inverse of a function. Inverse of a function is a learning expectation in the Mathematics 33 course of studies that students writing 1997 examinations were better at understanding. Of students who wrote the examination, 43.9% met the expectation for this question.

An expectation of Mathematics 33 is that students can demonstrate understandings of functions when presented with either ordered pairs, graphs, or generalized forms. **Numerical-response question 2** requires students to demonstrate their understanding of the concept of domain when given a generalized form. Students could approach this problem from either ordered pairs or a graph. Of the students who wrote the examination, 78.7% of the students met the expectation for this question.

Other relations and functions questions included in the examination gave students an opportunity to demonstrate their understanding of the relationship between generalized functions and graphical representations. In this context, students appeared to have difficulty visualizing the graph of a linear function. An example of this would be multiple choice 12, where 45.4% of students who wrote the examination answered the question correctly, as compared with 82.8% of students meeting the standard of excellence.

This question, along with other embedded relations and functions questions, discriminated well between students generally and students who achieved the standard of excellence. Another example would be numerical response 3 where, of all students who wrote the examination, 62.9% answered correctly, compared with 90.8% of the students who achieved the standard of excellence. Overall, better students continue to demonstrate increasing strength on relations and functions questions.

Statistics — To achieve the acceptable standard in statistics, students must be able to organize, analyze, and draw inferences from bivariate data and from data obtained through yes/no surveys. Students are also expected to determine the results of yes/no surveys with measurable degrees of confidence.

Use the following information to answer the next question.

A sports reporter used statistics and a data booklet containing 90% box plots from sample sizes of 20, 40, 80, and 100 to draw inferences about the number of Olympians qualifying for an event. From a random sample of Olympians trying out for the event, the reporter determined that 60% qualified. The reporter wrote "Based on this sample, the 90% confidence interval for the percentage of Olympians who qualified out of those trying out for this event is between 40% and 75%."

Numerical Response

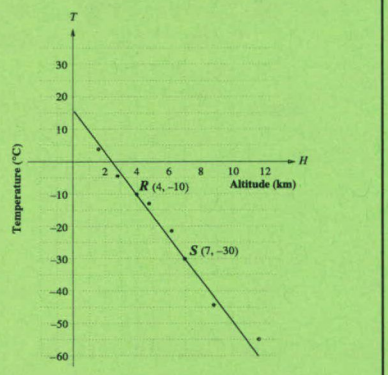
11. Given the statement the reporter wrote, the sample size surveyed must have been _____.

(Record your answer on the answer sheet.)

Answer: 20

Use the following information to answer the next question.

Data from a satellite were used to construct the following scatter plot, which relates the altitude above Earth's surface to air temperature. A line of best fit has been included.



29. Given the points R and S, the equation the line of best fit is

***A.** $T = -\frac{20}{3}H + \frac{50}{3}$

B. $T = -\frac{3}{20}H - \frac{47}{5}$

C. $T = -\frac{1}{150}H + \frac{50}{3}$

D. $T = -\frac{1}{150}H - \frac{110}{3}$

Numerical-response question 11 is a non-routine question when compared with questions asked on previous examinations. Rather than asking for confidence boundaries, confidence boundaries are given and the sample size surveyed is requested. Of all the students writing this examination, only 47.5% answered this question correctly. Students wishing to better achieve the standards should be aware of the inter-relationship between box plots/confidence intervals and various other ways that concepts related to box plots can be used and tested.

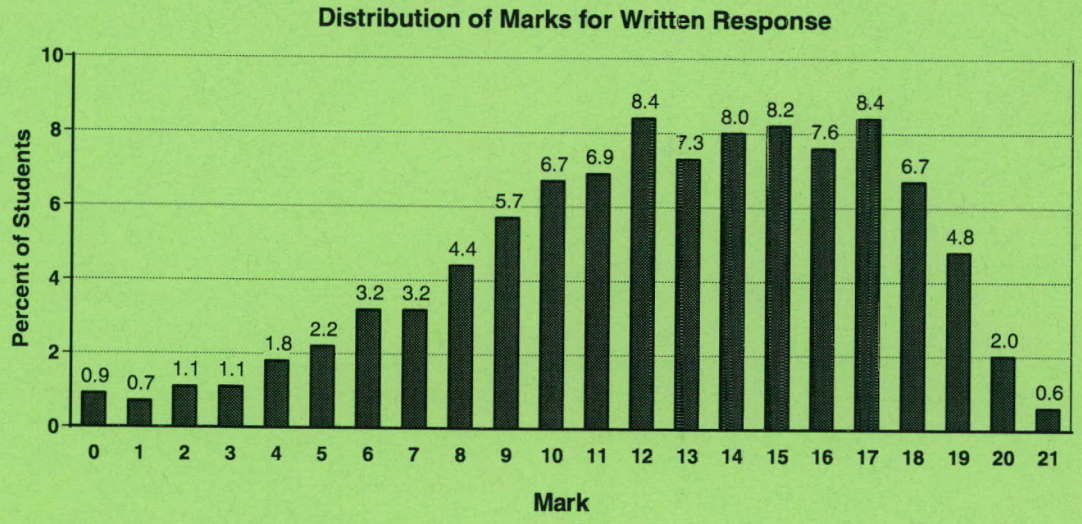
Multiple-choice question 29 is related to procedural understanding and the use of bivariate data. In this question, real-life data has been organized for the student on a scatter plot, with a line of best fit drawn. In the past, students had trouble with simple conceptual understandings such as identifying correlation and strength. They incorrectly used the slope of a line of best fit to identify strength. But this has improved, as 80.2% correctly answered a routine question (multiple choice 33) related to correlation.

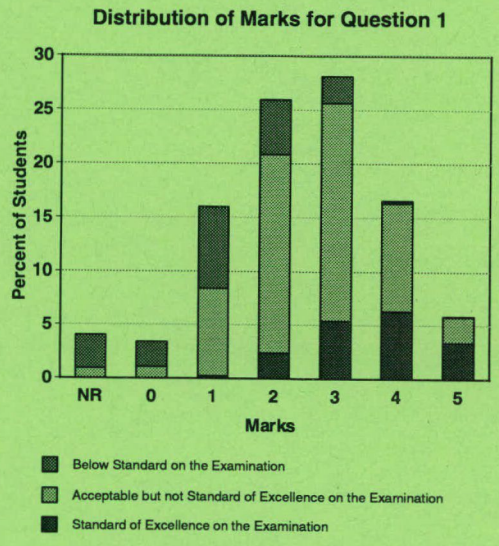
Students seemed challenged by multiple-choice question 29. Before the introduction of the Mathematics 33 Diploma Examination, few students attempted this type of question. It requires students to derive the equation for the line of best fit. Of all students writing the examination, 53.0% answered correctly, as did 75.9% of students who achieved the standard of excellence.

Overall, the results suggest more students are stronger in the area of statistics than in the past. Students at the standard of excellence also continue to improve their strength in statistics, but more of these students should be getting questions like multiple choice 29 correct.

Written-Response Questions

The chart below shows the percentage of students achieving various marks on the written-response questions. The maximum mark obtainable was 21. Questions in the written-response section dealt with four of the seven content strands for Mathematics 33. Students achieving the acceptable standard were expected to obtain at least half of the possible marks on all questions. Students achieving the standard of excellence were expected to get almost full marks.




Distribution of Marks for Question 1
Percent of Students
Marks
NR
Below Standard on the Examination
Acceptable but not Standard of Excellence on the Examination
Standard of Excellence on the Examination

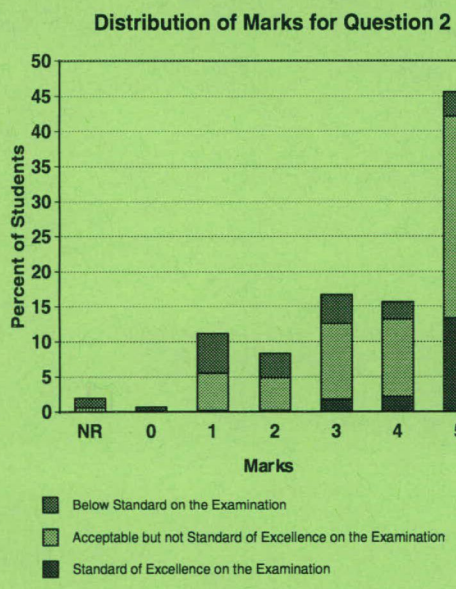
Question 1 required students to apply and explain the effects of various parameters in transforming the graphs of quadratic functions. The question was marked with a five-point holistic scale. Students who achieved the acceptable standard but not the standard of excellence were expected to score at least 3 of 5 marks on this question and 53.3% of them did so. Students achieving the standard of excellence were expected to correctly complete the solution with supporting detail and clearly communicate reasons in a logical order. The percentage of students at the standard of excellence achieving either 4 or 5 marks on this question was 54.8%.

On this 5-mark question, the average was 2.48 or 49.6%.

Overall, the teachers marking this question were impressed with student responses that demonstrated understanding of transformations, graphs, and equations. However, the answers often neglected the effect of the parameter "a" in explaining range, and clear statements about range, such as stating the range is less than or equal to a specific value such as 2, were often absent. Instead, students typically wrote, "the range is 2." Other weaknesses in student responses included using the wrong quadrant numbers and using the *x*/*y*-axis to describe a quadrant. Not referencing back to the equation was another common weakness, and building a function such as $y = 2(x - 2)^2 + 2$ without providing enough supporting detail to clearly reference which 2 was being described was a typical communication error.

The main strength of responses was the recognition of the transformational effects parameters *a*, *h*, and *k* have on the graph of the equation $y = a(x - h)^2 + k$. Most students provided good supporting detail when explaining the transformational effects. However, it was also evident that proper use of mathematical language and terminology would have enhanced many students grades. Common problems include the use of the word "equation" to mean graph, the word "intercept" to mean vertex, the word "inverse" in place of

reflection, and the expression "y-intercept" to mean range. In some cases, the vocabulary of transformational effect was absent. The word "shrunk" was used to describe a transformational effect.

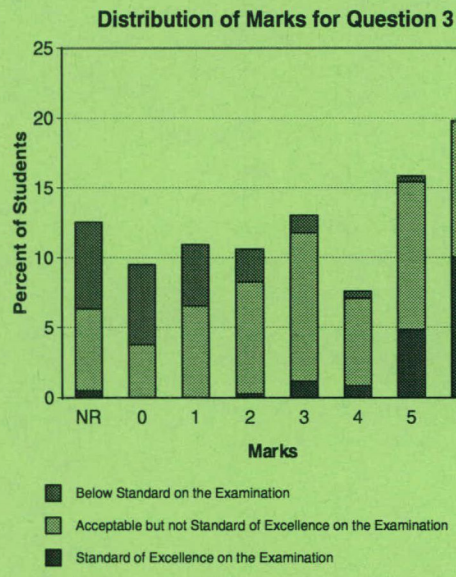


Question 2 required students to use loan tables to determine the amount of a loan, do a comparative analysis of two loans, and provide and justify a recommendation based on the comparative analysis. The question was scored using holistic scoring criteria with a scale of five. It was expected that students achieving the acceptable standard but not the standard of excellence would score at least 3 of 5 marks on this question and 82.5% did so. Students achieving the standard of excellence were expected to correctly complete the solution with proper supporting detail that was organized logically and clearly. Of students writing the examination, 61.3% achieved the standard of excellence on this question, and for students at the standard of excellence, 87.5% scored 4 or 5 marks.

On this 5-mark question, the average mark was 3.69 or 73.8%.

Markers noted that responses to this question were typified by in-depth answers that considered several factors in deriving concluding statements and demonstrated careful interpretation of the problem being solved. Markers were also impressed by responses that provided strong logical answers in the absence of perfect calculations. It was also noted that there were very few syntax errors, such as the omission of "$" signs. This is an improvement from previous examinations. Almost all students supplied some kind of reasoning or justification: there were very few unsupported answers such as "I would recommend Bank Option B." In addition, of 5 645 examinations written, only 107 papers contained no response.

Markers noted several weaknesses in responses to this question, the first of which was determining the proper table and/or cell to be used when solving a loan problem. Often, students used a mortgage table rather than a loan table. Students should be aware that mortgage and loan tables are very different, as interest on mortgages can only be compounded semi-annually according to law. Another concern was that a significant number of students did not show supporting details and/or poorly communicated their responses. Examples of this include not supporting calculated answers, leaving out concluding statements, and missing minor details (such as dollar signs). The inclusion of correct supporting detail can mean the difference between being awarded 3 or 4 marks or even between 4 or 5 marks out of the 5 marks possible.



Question 3 required students to solve an applied trigonometry problem involving oblique and right triangles and to do a cost analysis based on determined measures.

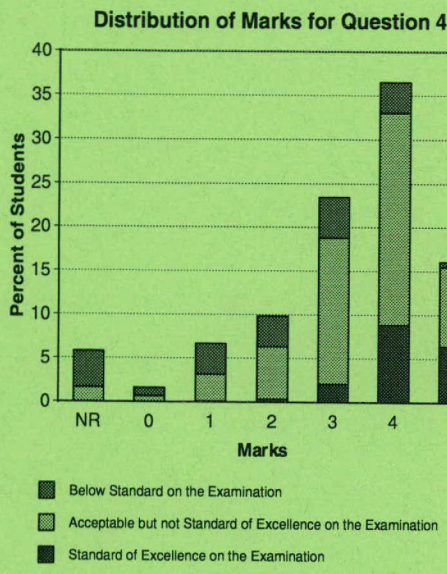
This question was marked using a holistic scoring guide that included two scales — one scale of 4 marks for parts a and b, and a second scale of 2 marks for part c. Students who achieved the acceptable standard but not the standard of excellence were expected to score at least 3 of the 6 marks. Of these students, 60.5% received 3, 4, 5, or 6 marks on this question. Students who achieved the standard of excellence were expected to score 5 or 6 marks on this question, and 83.7% did so.

On this 6-mark question, the average mark was 3.17 or 52.8%.

As was the case with the January 1997 examination, the markers were impressed with the problem-solving ability students demonstrated in their responses to this question. Students used a variety of approaches and strategies. Overall, responses were well-structured, organized, and communicated well, with rounding and proper units.

Markers reported a higher number of zeros and more "no responses" for this question than expected. In fact, of 5 645 possible responses, there were 215 zeros and 359 no responses. Students wishing to receive a mark of one or better must be better able to make a significant start. Markers reported that some students need to improve visualization skills such as recognizing appropriate triangles in applied mathematical diagrams and beginning with appropriate values as determined from the information provided. Markers did not tolerate responses that began with contrived angles or values. Further to this, solving a triangle that was not related to the information provided was not considered a significant start.

Other weakness in responses included difficulty in calculating simple trigonometric ratios, using proper mathematical syntax, and communicating answers. As well, difficulty in calculating accurately for the cosine law or applying right-triangle properties continue to be a concern.



Question 4 required students to interpret and analyze real-life graphs in the context of conceptual understanding from three units: Relations and Functions, Trigonometry, and Quadratic Functions and Equations. This question was marked on a 5-point holistic scale. It was expected that students achieving the acceptable standard but not the standard of excellence would score at least 3 of 5 marks on this question, and 81.7% did so. Of the students who achieved the standard of excellence, 85.9% achieved either 4 or 5 marks.

On this 5-mark question, the average mark was 3.23 or 64.6%.

The strengths of responses to this question included evidence that students understood the intended scope of the problem: 92.6% of students scored one mark or better. Many responses demonstrated that students have strength in reading graphs, clearly identifying horizontal/vertical distances, and communicating interpretations of graphs.

Some of the weaknesses markers identified included comparisons made without qualification or quantification, rationales not linked to mathematics to justify answers, various errors made in reading graphs, and the use of incorrect language such as "height is 75°." Other responses led markers to believe students do not understand directing words such as *compare*. Directing words have been defined in the information bulletin so that students can better know how to respond to written-response questions.

In conclusion, students attempting to attain higher marks on questions such as this one would have been well advised to pay careful attention to directing words, ensure any analysis done is both qualified and quantified, and provide a response that is communicated clearly with supporting detail.

For further information, contact Ron Flaig(rflaig@edc.gov.ab.ca) or Phill Campbell (pcampbell@edc.gov.ab.ca) at the Student Evaluation Branch at 427-0010. To call toll-free from outside of Edmonton, dial 310-0000.

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